PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventor: JOSEPH THOMAS HEINSON

1,104,093

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COMPLETE SPECIFICATION

Improvements relating to Electrodes for Storage Batteries

We, PRITCHETT & GOLD AND E.P.S. COMPANY LIMITED, a Company registered under the Laws of Great Britain, of Dagenham

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Page 1, Heading, Application Date: *for* "Nov. 12, 1962." *read* "Nov. 12, 1963."

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THE PATENT OFFICE
25th March 1968

bars, a number of transverse bars some of which extend between the sides of the grid adjacent the lug while some extend between the sides remote from the lug, in which the grid is divided into two or more zones at different distances from the lug, the individual cross-section of the majority of the radial bars in one zone being greater than that of the majority of radial bars in another zone further from the lug.

If desired each transverse bar may lie along a straight line extending from edge to edge of the grid, for example parallel to the diagonal which does not approach the lug. In general, however, it is preferred to employ transverse bars which roughly follow concentric arcs having their centre in the region

progressively increases. It is generally desirable that the size of the pellets of active material should not vary too greatly, and this may be achieved by introducing intervening short radial bars between the full length radial bars, the short radial bars extending from the opposite sides of the plate only part of the way towards the lug and terminating at a chosen transverse bar.

Thus in a preferred arrangement the number of radial bars in a zone is less than the number of radial bars in another zone further from the lug. The invention does not exclude arrangements in which radial bars in one zone are staggered or offset in relation to those of an adjacent zone, but it is preferred that each radial bar in a zone nearer to the lug

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COMPLETE SPECIFICATION

Improvements relating to Electrodes for Storage Batteries

We, PRITCHETT & GOLD AND E.P.S. COMPANY LIMITED, a Company registered under the Laws of Great Britain, of Dagenham Dock, Essex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to electrodes for storage batteries and is concerned with the formation of the conducting grid for supporting and retaining the active material and providing the necessary mechanical strength in a substantially rectangular battery electrode having a connecting lug adjacent one corner.

An object of the invention is to reduce the effective resistance of the current path from the active material to the connecting lug for a given weight of metal.

According to the present invention the grid comprises a number of radial bars extending along lines which pass through or close to the lug, and, intersecting the radial bars, a number of transverse bars some of which extend between the sides of the grid adjacent the lug while some extend between the sides remote from the lug, in which the grid is divided into two or more zones at different distances from the lug, the individual cross-section of the majority of the radial bars in one zone being greater than that of the majority of radial bars in another zone further from the lug.

If desired each transverse bar may lie along a straight line extending from edge to edge of the grid, for example parallel to the diagonal which does not approach the lug. In general, however, it is preferred to employ transverse bars which roughly follow concentric arcs having their centre in the region of the lug. Thus each transverse bar may be curved, or it may be formed of a number of straight lengths each extending from a radial bar to the next or a neighbouring radial bar along or approximately along a chord of the arc referred to. Each boundary between adjacent zones may conveniently follow a transverse bar.

As current is fed into a radial bar at points distributed along its length the amount of current in the part of the bar nearest to the lug will be greater than that in parts further away, and it can be shown that the voltage drop in these circumstances is greater in a uniform bar than if the same amount of metal is employed in a bar which is thicker in the part nearer the lug and thinner in the part remote from the lug.

With a number of full length radial bars each extending from the lug to an opposite side of the plate the space between adjacent bars increases with the distance from the lug, and hence, with a number of equally spaced circumferential or other transverse bars, the size of each pellet of active material progressively increases. It is generally desirable that the size of the pellets of active material should not vary too greatly, and this may be achieved by introducing intervening short radial bars between the full length radial bars, the short radial bars extending from the opposite sides of the plate only part of the way towards the lug and terminating at a chosen transverse bar.

Thus in a preferred arrangement the number of radial bars in a zone is less than the number of radial bars in another zone further from the lug. The invention does not exclude arrangements in which radial bars in one zone are staggered or offset in relation to those of an adjacent zone, but it is preferred that each radial bar in a zone nearer to the lug

should form a continuation of a radial bar in an adjacent zone further from the lug.

The theoretical design of the bars may be undertaken on the basis of the following assumptions.

a) that the electrical function of the transverse bars is solely to conduct current to the radial bars,

b) that current is generated uniformly in the active material so that the current in a radial bar is proportional to the volume of active material it serves, and,

c) that the best performance is obtainable from the electrode when the voltage drop is uniform along a radial bar.

In the case of a continuous radial bar drawing current from a fan-shaped sector of active material (neglecting the volume occupied by the bar), the cross-section of the bar required at a radius r to fulfil the above assumptions would be proportional to $r_0^2 - r^2$, where r_0 is the outside radius. This would result in a bar having its cross-section varying continuously in accordance with a convex parabolic curve, having a point at the end remote from the lug, thence thickening rapidly at first and progressively more gradually towards the lug.

In practice a number of compromises are required. In the first place it may not be convenient to cast bars of continuously changing cross-section, and it may therefore be preferable to regard each radial bar as being divided into portions each of which is of uniform section approximating to the optimum mean section. Secondly as indicated above the use of radial bars all of which extend from the lug to the opposite sides of the plate would result in the pellets of active material increasing in width from an unduly small size in the region of the lug to an unduly large size at the opposite side. For this reason the plate is conveniently divided into concentric zones, the number of radial bars in an outer zone being greater than that in an inner zone so that the sizes of the pellets remain within a given range. Thirdly, the formula given above, especially where the area in an outer zone is divided by an increased number of radial bars, would tend to result in inconveniently thin bars in an outer zone. Accordingly it may be convenient to depart from the formula for the outermost zone and simply adopt radial bars giving the maximum acceptable pellet size and having the minnimum section that can in practice be conveniently cast.

It is, however, preferred that the total cross-section of all the radial bars in a zone should be greater than the total cross-section of all the radial bars in a zone further from the lug.

The invention may be put into practice in various ways but one specific embodiment will be described by way of example with reference to the accompanying drawing in which the single figure is a view of a conducting grid for a lead-acid cell intended for aircraft use, in which it is important to improve performance without increasing weight.

The grid is of the usual rectangular form having a peripheral conducting bar 10 along its sides and a connecting lug 11 at one corner. Instead of the usual parallel vertical and horizontal bars, however, the grid is provided with radial bars radiating from the region of the lug and arcuate transverse bars having their centre in the region of the lug. The number of radial bars is a minimum in an inner region adjacent the lug whilst in an intermediate region the number is greater than in the inner region and in an outer region it is greater than in the intermediate region.

In the specific embodiment the grid 10 is approximately 5½ inches square and .08 inch thick and is divided into three concentric zones 20, 21 and 22 by arcuate boundary bars 23 and 24 at radii of about 1.2 and 3.1 inches struck about a centre in the region of the lug 11. In the outer zone 22 furthest from the lug there are forty-six radial bars 25 each having a section of .00106 sq. ins; in the middle zone 21 there are twenty-four radial bars 26 each having a section of .00232 sq. ins; whilst in the inner zone there are four stout bars 27 each having a section of .01594 sq. ins. Each of the radial bars in the inner zone is of the full thickness of the grid; whilst the radial bars of the middle and outer zones are each half the total thickness and extend on only one side of the central plane, alternately on opposite sides.

Accordingly the total cross-section of all the radial bars in the outer zone is .04876, in the middle zone is .05168 and in the inner zone is .06376 sq. ins.

In addition the inner zone has one intermediate arcuate bar 28, the middle zone has five intermediate arcuate bars 29 and the outer zone has twelve intermediate arcuate bars 30. Each of the arcuate bars 28 and 29 in the inner and middle zones is of the full thickness of the grid and has a section of .00465 sq. ins. whilst the arcuate bars 30 in the outer zone each extend on one side of the central plane, alternately on opposite sides, and are of the same section as the adjacent radial bars, namely .00106 sq. ins.

It will be appreciated that the invention is not limited to the construction specifically described. Thus in the construction described all the radial bars in the same zone are of the same section. In certain instances it may be desirable to employ radial bars of differing section in the same zone. For example a bar extending diagonally from the lug to the opposite corner may in some cases with advantage be made thicker than a bar extend-

ing roughly horizontally or vertically from the lug. Again with plates that are not of square shape, for example whose height is greater than their width, it may be desirable to divide the area into two regions separated by an oblique radial bar, and employ stouter radial bars in the lower region than in the upper region.

The grid has been described as having arcuate bars extending between the radial bars. In some cases it may be convenient to employ straight bars in place of the arcuate bars, the straight bars lying along chords of the arcs. In such an arrangement each transverse bar may lie along a straight line from one radial bar to the next, or extending across a number of radial bars, or even along a straight line extending from edge to edge of the grid. Such an arrangement may in some cases provide greater mechanical strength.

WHAT WE CLAIM IS:—

1. A conducting grid for supporting and retaining the active material and providing the necessary mechanical strength in a substantially rectangular battery electrode having a connecting lug adjacent one corner, comprising a number of radial bars extending along lines which pass through or close to the lug, and, intersecting the radial bars, a number of transverse bars some of which extend between the sides of the grid adjacent the lug while some extend between the sides remote from the lug, in which the grid is divided into two or more zones at different distances from the lug, the individual cross-section of the majority of the radial bars in one zone being greater than that of the majority of radial bars in another zone further from the lug.

2. A conducting grid for supporting and retaining the active material and providing the necessary mechanical strength in a substantially rectangular battery electrode having a connecting lug adjacent one corner, comprising a number of radial bars extending along lines which pass through or close to the lug, and intersecting the radial bars, a number of transverse bars roughly following concentric arcs having their centre in the region of the lug, in which the grid is divided into two or more zones at different distances from the lug, the individual cross-section of the majority of the radial bars in one zone being greater than that of the majority of radial bars in another zone further from the lug.

3. A grid as claimed in Claim 1 or Claim 2 in which each boundary between adjacent zones follows a transverse bar.

4. A grid as claimed in any one of the preceding claims in which the number of radial bars in a zone is less than the number of radial bars in another zone further from the lug.

5. A grid as claimed in any one of the preceding claims in which in each zone each radial bar is of substantially uniform cross-section.

6. A grid as claimed in any one of the preceding claims in which the total cross-section of all the radial bars in a zone is greater than the total cross-section of all the radial bars in a zone further from the lug.

7. A grid as claimed in any one of the preceding claims in which each radial bar in a zone nearer to the lug forms a continuation of a radial bar in an adjacent zone further from the lug.

8. A grid as claimed in any one of the preceding claims in which in one zone the radial bars are of the full thickness of the grid whilst in another zone further from the lug they are only half the thickness of the grid.

9. A grid for a battery electrode as specifically described herein with reference to the accompanying drawing.

KILBURN & STRODE,
Chartered Patent Agents.
Agents for the Applicants.

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1 SHEET *This drawing is a reproduction f the Original on a reduced scale*